1. SUMMARY

The Savannah River Plant (SRP) near Aiken, South Carolina, is a major installation of the Department of Energy for the production of nuclear materials for national defense. It began operations in the early 1950's and is currently the Nation's primary source of reactor-produced defense materials. The SRP operations also produce liquid high-level radioactive waste from the chemical processing of fuel and target materials after irradiation in the SRP nuclear reactors. The high-level waste has been and is continuing to be stored safely in underground tanks that are engineered to provide reliable storage of the waste isolated from the environment. No on-site or off-site radiation injuries have occurred from these operations, nor has there been any off-site contamination. However, some local leaks and spills have occurred, and the tanks have to be replaced at regular intervals (20-50 years). The impacts of present and relatively near-term management of this tank storage were developed in a previous environmental statement issued in final form in September 1977.*

The present statement explores the environmental implications of a large research and development (R&D) program aimed at developing the proposed continuation of technology for removing the wastes from the tanks and immobilizing the radionuclides in solid forms for subsequent disposal. Any later proposals to take action of potentially significant impact, such as the construction of a major waste treatment facility or the construction of a permanent waste repository, will be covered in subsequent project-specific environmental reviews.

The proposed R&D program is directed toward developing technology for converting the waste into two fractions: a durable waste form containing over 99% of the radioactivity, and decontaminated salt, with storage or disposal of the waste form, e.g., in an off-site geological repository, an on-site surface storage vault, or an on-site geological repository (bedrock cavern) and storage of the salt in: decontaminated waste tanks at SRP, an on-site surface vault, or an off-site geologic repository.

The following alternatives to the proposed immobilization R&D program are assessed for environmental impact:

- o continue storing high-level waste in subsurface storage tanks, which is a continuation of the present management practice.
- o slurry the high-level waste into bedrock caverns, an on-site geological repository. (This alternative has been designated as environmentally unacceptable by the U.S. Environmental Protection Agency (EPA)).

* Environmental Impact Statement, Waste Management Operations, Savannah River Plant. Report ERDA-1537, Energy Research and Development Administration (September 1977).

Throughout the document, storage will mean that the waste is retrievable with only moderate effort and should have some surveillance and maintenance by man. Storage may continue indefinitely, or may later be replaced by disposal. Disposal will mean that there is no intent that the waste would be retrieved. Some disposal options provide for retrievability for periods of years after emplacement of the waste.

The proposed R&D program allows for the development of a variety of waste forms. The reference waste form for Savannah River wastes is borosilicate glass monoliths, but programs at a variety of DOE sites are investigating concretes, calcines, high-silica glasses, clay ceramics, crystalline mineral analogues such as supercalcines, and SYNROC, glass ceramics, metal matrices, and multibarrier forms (see Section IV.D). The proposed engineering development effort on an immobilization plant design will be undertaken with sufficient flexibility so as not to foreclose any of the reasonable alternative forms under consideration prior to completion of a project specific environmental review.

The method for disposal subsequent to immobilization has not yet been chosen and alternative disposal options are not addressed in this EIS. This work falls under a separate DOE program and will be addressed in separate environmental reviews. Generic analyses of the impacts of geologic disposal of engineered surface storage subsequent to immobilization are presented in this statement. The waste form and container size could be made compatible with any geologic disposal option or any surface storage option. The outer container material may change depending upon the type of geologic formation, and engineered barriers may be used as a buffer between the waste form and the repository. The waste form technology development program will consider compatibility of the waste form with the host rock and with the outer container and engineered barrier materials. Cost differences among the off-site repository options also have little influence on the technology development program because they are small compared to total implementation costs of the alternative being developed. The variation in geologic cavern capital and operating costs shown in Section X between an off-site repository in salt ($200 million) and an off-site repository in rock ($390 million) is typical of the range to be expected. The difference of $190 million between these is about 5% of the total cost of the geologic disposal option.

Pertinent analyses of the geologic disposal option and other disposal options are included in the draft *EIS on Management of Commercially Generated Radioactive Waste*, DOE/EIS-0046-D, April 1979. These other options include chemical resynthesis, disposal in very deep holes, island disposal, sub-seabed geologic disposal, ice sheet disposal, reverse-well disposal, partitioning and transmutation, and space disposal.

Chemical resynthesis requires waste immobilization into synthetic minerals; the very deep hole, sub-seabed, ice-sheet, island and space disposal options require immobilization into a high-integrity form; and partitioning and transmutation requires separation of the wastes followed by immobilization of portions of the high-level fraction. The proposed R&D program is sufficiently broad in its initial stages so that it can be modified in later stages, as appropriate, to meet the needs of these options.

The remaining two options, disposal by rock melting or reverse-well disposal, involve direct disposal of liquid wastes in rock. These options are represented in this EIS by the alternative of liquid waste disposal in bedrock.

A summary of key quantifiable environmental impacts and costs of each alternative is given in Table I-1. The risk items shown in Table I-1 are discussed more fully in Section V, and the costs are covered in Section X.

There are no substantial environmental impacts arising from nuclear radiation for any of the three alternatives. Some of the individual doses in the SRP on-site cases are of concern; however, they could occur to only a limited number of people. The off-site population exposure risk from the alternative with highest risk (liquid waste stored in an SRP bedrock cavern) is more than one-thousandfold lower than natural radiation exposure to the same population. The factor of 200 cancer deaths per million man-rem recommended by the EPA can be used to convert the exposures from Table I-1 to possible health effects. This dose-effect relationship probably overestimates the actual radiation effects, as discussed in Section XII. Based on the EPA factor, the alternative with the highest off-site risk (slurry into bedrock) would result in 12 fatalities over a 300-year period, whereas the same population would experience about 46,000 fatalities over the 300-year period from natural radiation effects. Over a 10,000-year period, the risk would be 28 fatalities versus about 2,000,000 fatalities from natural radiation.

Nonnuclear fatalities to be expected from construction and operating activities related to each alternative are greater than those that would be expected from radiation effects, but are no larger than the risks voluntarily accepted by industrial workers.

The most significant quantifiable differences between the alternatives are the differences in budgetary costs. As shown in Section XI, none of the alternatives approaches the trade-off value of $1000 per man-rem for expenditures beyond the least expensive alternative (continued tank farm operation). (The value of $1000 per man-rem is somewhat arbitrary, and is used in this document as an example of how radiation risks might be evaluated and compared with monetary costs.)

Cost considerations and how they are balanced in a judgmental manner with the unquantifiable factors listed in Table I-2 are elements in deciding whether to proceed with the proposed program. Off-site radiation risks, occupational exposures, nonnuclear risks, and other environmental effects are small in absolute magnitude for all options analyzed.

Orientation of the proposed Savannah River technology development program toward conversion of the waste to a high-integrity form for subsequent disposal has been influenced by public opinion and perception of risks, as expressed through governmental bodies and special interest groups. For example, comment letters on the draft of this statement were received from the Governor of the State of Georgia indicating opposition to bedrock disposal of waste under the SRP site, and from the U.S. Environmental Protection Agency categorizing any bedrock disposal option at SRP as Environmentally Unsatisfactory.